

WHAT IS CLAIMED IS:

1. A diamond high brightness ultraviolet ray emitting element comprising:

5 a diamond substrate; and

 a diamond crystal formed on the diamond substrate to high-density excitation;

 whereby the light-emitting mechanism a carrier high-density phase which is formed by subjecting a diamond
10 crystal to high-density excitation.

2. The diamond high brightness ultraviolet ray emitting element as claimed in claim 1, wherein the high-density excitation has an intensity equal to or greater than 10^{20}
15 cm^{-3} in terms of a carrier density, or equal to or greater than 100 Acm^{-2} in terms of a current density.

3. The diamond high brightness ultraviolet ray emitting element as claimed in claim 2, wherein a region for carrying
20 out the high-density excitation is spatially limited to an area equal to or less than 0.01 cm^2 .

4. The diamond high brightness ultraviolet ray emitting element as claimed in claim 3, wherein the region for carrying
25 out the high-density excitation is formed by etching.

5. The diamond high brightness ultraviolet ray emitting

element as claimed in claim 3, wherein the spatial restriction of the region for carrying out the high-density excitation is formed by diamond isolated particles.

5 6. The diamond high brightness ultraviolet ray emitting element as claimed in claim 1, wherein a region for carrying out the high-density excitation is spatially limited to an area equal to or less than 0.01 cm^2 .

10 7. The diamond high brightness ultraviolet ray emitting element as claimed in claim 6, wherein the region for carrying out the high-density excitation is formed by etching.

15 8. The diamond high brightness ultraviolet ray emitting element as claimed in claim 6, wherein the spatial restriction of the region for carrying out the high-density excitation is formed by diamond isolated particles.

20 9. The diamond high brightness ultraviolet ray emitting element as claimed in claim 1, further comprising a structure for controlling temperature equal to or lower than 170 K when using electron-hole droplets, and equal to or higher than 160 K when using electron-hole plasma.

25 10. The diamond high brightness ultraviolet ray emitting element as claimed in claim 1, further comprising a spatial confinement structure of the carriers.

11. The diamond high brightness ultraviolet ray emitting element as claimed in claim 10, wherein the spatial confinement structure of the carriers comprises a stack
5 of layers including at least two layers with different electric characteristics.

12. The diamond high brightness ultraviolet ray emitting element as claimed in claim 11, wherein the spatial
10 confinement structure of the carriers comprises one of a pn junction and a pin junction.

13. The diamond high brightness ultraviolet ray emitting element as claimed in claim 10, wherein the spatial
15 confinement structure of the carriers comprises one of a pn junction and a pin junction.

14. The diamond high brightness ultraviolet ray emitting element as claimed in claim 13, wherein the one of the pn
20 junction and the pin junction comprises a p-type layer composed of a boron-doped diamond.

15. The diamond high brightness ultraviolet ray emitting element as claimed in claim 13, wherein the one of the pn
25 junction and the pin junction comprises an n-type layer composed of a phosphorus-doped diamond or sulfur-doped diamond.

16. The diamond high brightness ultraviolet ray emitting element as claimed in claim 13, wherein the one of the pn junction and the pin junction comprises electrodes formed
5 on the p-type layer and the n-type layer.

17. The diamond high brightness ultraviolet ray emitting element as claimed in claim 16, wherein said electrodes are composed of titanium.

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18. The diamond high brightness ultraviolet ray emitting element as claimed in claim 10, wherein the confinement structure is formed by introducing crystal defects into a region of the crystal by at least one of methods consisting
15 of an impurity doping, neutron beam irradiation, and distortion introduction.

19. The diamond high brightness ultraviolet ray emitting element as claimed in claim 1, wherein isotope composition
20 ratio of at least part of the diamond is controlled.

20. The diamond high brightness ultraviolet ray emitting element as claimed in claim 19, wherein purity of ^{12}C or ^{13}C is controlled equal to or greater than 90% in the control
25 of the isotope composition ratio of the diamond.

21. The diamond high brightness ultraviolet ray emitting

element as claimed in claim 1, comprising a diamond substrate that functions as a heat sink.

22. The diamond high brightness ultraviolet ray emitting
5 element as claimed in claim 1, wherein the diamond crystal has a nitrogen concentration equal to or less than 10 ppm.

23. The diamond high brightness ultraviolet ray emitting
10 element as claimed in claim 1, wherein the diamond crystal has a boron concentration equal to or less than 100 ppm.

24. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 1, further comprising an optical
cavity, and operating as a laser.

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25. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 24, wherein a reflection
wavelength of reflecting mirrors constituting said optical
cavity, and a cavity length are optimized for an emission
20 wavelength of EHD or EHP.

26. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 24, wherein said optical cavity
comprises reflecting mirror planes formed by etching.

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27. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 24, wherein said optical cavity

comprises reflecting mirror planes formed by a (111) cleaved plane.

28. The diamond high brightness ultraviolet ray emitting
5 element as claimed in claim 24, wherein said optical cavity
comprises reflecting mirror planes formed by a naturally
formed plane of isolated particles.

29. The diamond high brightness ultraviolet ray emitting
10 element as claimed in claim 24, wherein said cavity is
composed of micro-spheres.

30. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 24, wherein said optical cavity
15 comprises reflecting mirrors composed of an Al film.

31. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 24, wherein said optical cavity
comprises reflecting mirrors composed of a dielectric
20 multilayer film.

32. A bactericidal lamp that employs the diamond high
brightness ultraviolet ray emitting element as defined in
claim 1 as a light source.

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33. A lighting system that employs the diamond high
brightness ultraviolet ray emitting element as defined in

claim 1 as a pumping source for fluorescent materials.

34. An optical disk drive that employs the diamond high
5 brightness ultraviolet ray emitting element as defined in
claim 1 as a light source for reading
information.

35. A semiconductor lithographic exposure system that
10 employs the diamond high brightness ultraviolet ray
emitting element as defined in claim 1 as
a light source.

36. A semiconductor pattern test system that employs the
15 diamond high brightness ultraviolet ray emitting element
as defined in claim 1 as a light source.

37. A medical laser scalpel system that employs the diamond
high brightness ultraviolet ray emitting element as defined
20 in claim 1 as a light source.

38. A diamond high brightness ultraviolet ray emitting
element comprising:
a diamond substrate;
25 a first diamond layer formed on the diamond substrate;
a second diamond layer formed on the first diamond layer
and functioning as an emission layer;

a third diamond layer formed on the second diamond layer;
a first electrode formed on the first diamond layer;
and

a second electrode formed on the third diamond layer,
5 wherein

the second diamond layer constitutes the carrier
high-density phase formed by high-density excitation.

39. The diamond high brightness ultraviolet ray emitting
10 element as claimed in claim 38, wherein the high-density
excitation has an intensity equal to or greater than 10^{20}
 cm^{-3} in terms of a carrier density, or equal to or greater
than 100 Acm^{-2} in terms of a current density.

15 40. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 38, wherein a region for carrying
out the high-density excitation is spatially limited to
an area equal to or less than 0.01 cm^2 .

20 41. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 38, wherein the region for
carrying out the high-density excitation is formed by
etching.

25 42. The diamond high brightness ultraviolet ray emitting
element as claimed in claim 38, wherein the spatial
restriction of the region for carrying out the high-density

excitation is formed by diamond isolated particles.